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Reaction energy of $O^{18}(d,p)O^{19}$

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With 2 figures in the text

By our previous measurements at the Nobel Institute of Physics, Stockholm, of proton groups from $O^{18}(d,p)O^{19}$ [refs. 1, 2] one energy region of about 150 keV could not be investigated due to an intense background of protons from $C^{12}(d,p)C^{13}$. Unfortunately, the region thus shadowed might contain the proton group for the transition to the ground state in O^{19}, the position of which was not accurately known by any other reaction.

However, at a considerably higher deuteron bombarding energy the same energy region will not be shadowed because of the different masses of C^{12} and O^{18}. In the earlier experiments we used a 0.855 MeV deuteron beam. A similar investigation has now been made at the Rice Institute, Houston, Texas, U.S.A., using a 4.98 MeV deuteron beam from the 6 MeV van de Graaff accelerator. The target was a 4 μ nickel foil, completely oxidized by enriched oxygen, holding about 37% O_2^{18} which had been obtained from Professor A. O. C. Nier, at the University of Minnesota. The secondary particles to be analysed were ejected from the target in the angle $\theta = 180°$ to the incident beam. An annular, homogeneous-field, magnetic spectrometer was used [3]. The magnetic field is calibrated with proton resonance. The solid angle of the instrument is about 1.6×10^{-4} steradians. Nuclear emulsion plates of Ilford E1 25 μ type were used for detection.

Fig. 1 shows the number of elastically scattered deuterons in the mass region around oxygen for a new target used in this work. Beside the peaks corresponding to O^{16} and O^{18} a slight contribution of O^{17} is seen. The target contained very little carbon before the runs (not shown in Fig. 1).

At the deuteron energy of 4.98 MeV a series of nuclear emulsion plates were exposed covering a region in proton energy from the most energetic of the known $O^{18}(d,p)O^{19}$ groups and 1 MeV upwards. Fig. 2 shows the proton spectrum obtained. The known O^{18} peak is seen to the extreme left of the figure near to the ground state peak of $C^{12}(d,p)C^{13}$. No other proton group had an intensity higher than 6% of the former group. We therefore conclude that the level scheme and the atomic mass of O^{19} given by us in ref. [2] are correct.

A new Q-value of the ground state transition of $O^{18}(d,p)O^{19}$ is obtained from Figs. 1 and 2. From the extrapolated high energy edge of the $O^{18}(d,d)O^{18}$ peak in Fig. 1, and the corresponding measured $B\varrho$ value of the magnet we get the value of the bombarding deuteron energy used during the experiments. From this energy, the extrapolated $O^{18}(d,p)O^{19}$ edge in Fig. 2 and the corresponding magnetic field we calculate the reaction energy. External layers on the target were not especially measured but a possible such layer can only introduce a minor error as the same

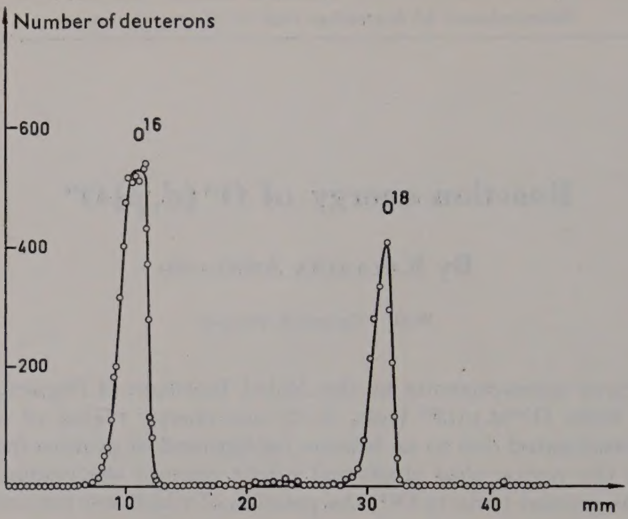

Fig. 1. Elastic scattering picture of the oxygen isotopes in the enriched O^{18} target. $E_1 = 4.98$ MeV. Each point gives the number of deuteron tracks in a 0.1 mm strip of the photographic plate per 100 μC deuteron bombardment of the target.

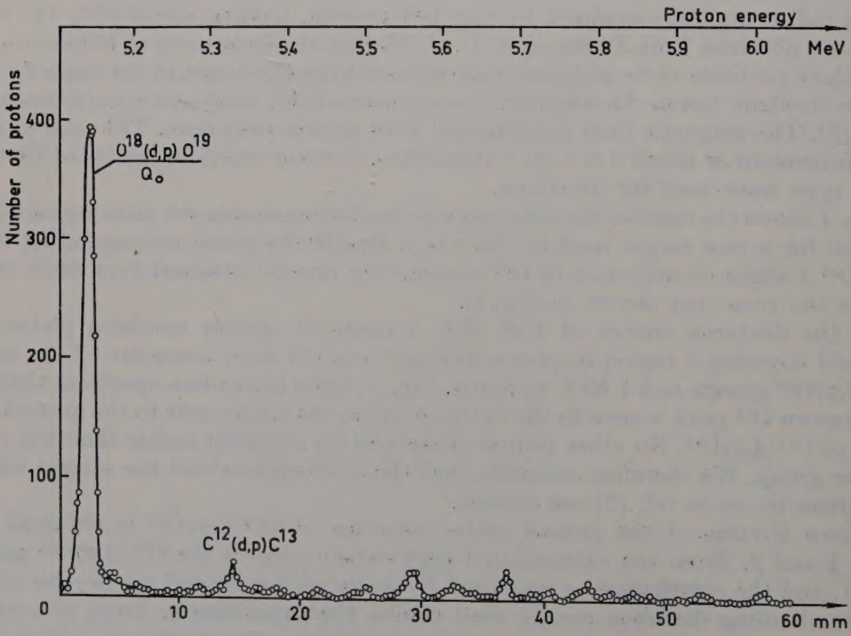

Fig. 2. Proton spectrum from an enriched O^{18} target bombarded with 4.98 MeV deuterons. Each point gives the number of proton tracks in a 0.1 mm strip of the photographic plate per 100 μC deuteron bombardment of the target.

isotope O^{18} was used both for the determination of the incident energy and of the Q-value. The result is $Q = 1734 \pm 5$ keV in good agreement with earlier values [1, 4, 5]. Our value measured in Stockholm was $Q = 1730 \pm 8$ keV which should be changed 1 keV upwards due to a recent adjustment of the $B\varrho$ value of the polonium-alpha particles (see [6]).

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REFERENCES

1. Ahnlund, K. and Mileikowsky, C., Ark. f. Fys. *8*, 161 (1954).
2. Mileikowsky, C. and Ahnlund, K., Phys. Rev. *96*, 996 (1954).
3. Klema, E. D. and Phillips, G. C., Phys. Rev. *86*, 951 (1952).
4. Thirion, J., Cohen, R., and Whaling, W., Phys. Rev. *96*, 850A (1954).
5. Holmgren, H. D., Hanscome, T. D., and Willett, D. K., Bull. Am. Phys. Soc. *29*, No. 7, R 6 (1954).
6. Wapstra, A. H., Physica *21*, 367 (1955).

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